Stoller
Hanford Office

DOE-EM/GJ1295-2006

299-E13-21 (A5866)
Log Data Report

Borehole Information:

Borehole: 299-E13-21 (A5866)			**Site:** 216-B-16 Crib		
Coordinates (WA St Plane)		**GWL (ft) :** 346.45		**GW Date:**	07/26/05
North	**East**	**Drill Date**	**Ground Level Elevation**	**Total Depth (ft)**	**Type**
134371	573618	10/55	Not available	355.2	Cable

[1] GWL – Groundwater Level

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Welded steel	1.7	6 5/8	6	5/16	1.7	140
Welded steel	0.0	8	unmeasured	5/16	0.0	365

Borehole Notes:

Casing diameter and stickup measurements for the 6-in. and 8-in. casings were acquired using a caliper and steel tape. The inside diameter of the 8-in. casing could not be measured due to grout fill between the casings. Measurements are rounded to the nearest 1/16 inch. Logging data acquisition is referenced to the top of casing (TOC). Depth to groundwater was measured with an e-tape by the logger.

Borehole 299-E13-21 is located on the northwest side of the 216-B-16 crib. It is correctly labeled and has both 6-inch and 8-inch casing visible at the ground surface. The well cap is oversized for the 6-inch casing, but appears to be serviceable. Borehole 299-E13-03 is located on the southeast side of the 216-B-16 crib, approximately 50 feet from 299-E13-21. Only 6-inch casing is visible at this location. The flanges on the well cap are bent, and the well casing is marked as internally contaminated. A map of the B/C cribs area in ARH-ST-156 shows the boreholes located as described above, and this is consistent with well locations derived from HWIS and Qmap. However, these boreholes have apparently been confused in the past—notably the 1992 Groundwater well reports are interchanged. Previous logs may have also been labeled with the wrong borehole.

Logging Equipment Information:

Logging System:	Gamma 1E		**Type:**	SGLS (70%) SN: 34TP40587A
Effective Calibration Date:	03/04/05	**Calibration Reference:**	DOE/EM-GJ864-2005	
		Logging Procedure:	GJO-HGLP 1.6.5, Rev. 1	

Logging System:	Gamma 1C		**Type:**	HRLS SN: 39-A314
Effective Calibration Date:	04/06/05	**Calibration Reference:**	DOE/EM-GJ1865-2005	
		Logging Procedure:	GJO-HGLP 1.6.5, Rev. 1	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4
Date	07/25/05	07/26/05	07/27/05	07/27/05
Logging Engineer	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	113.0	345.0	183.0	113.0
Finish Depth (ft)	2.0	182.0	114.0	78.0
Count Time (sec)	100	100	100	100
Live/Real	R	R	R	R
Shield (Y/N)	N	N	NA	NA
MSA Interval (ft)	1.0	1.0	1.0 ft	1.0 ft
ft/min	NA	NA	NA	NA
Pre-Verification	AE083CAB	AE084CAB	AE085CAB	AE085CAB
Start File	AE083000	AE084000	AE085000	AE085070
Finish File	AE083111	AE084163	AE085069	AE085105
Post-Verification	AE083CAA	AE084CAA	AE085CAA	AE085CAA
Depth Return Error (in.)	-1	+2	NA	+1
Comments	No fine gain adjustment made.	No fine gain adjustment made.	No fine gain adjustment made.	Repeat section

High Rate Logging System (NMLS) Log Run Information:

Log Run	5	6		
Date	07/28/05	07/28/05		
Logging Engineer	Spatz	Spatz		
Start Depth (ft)	26.0	18.0		
Finish Depth (ft)	13.0	15.5		
Count Time (sec)	300	300		
Live/Real	R	R		
Shield (Y/N)	N	N		
MSA Interval (ft)	0.5	0.5		
ft/min	NA	NA		
Pre-Verification	AC134CAB	AC134CAB		
Start File	AC134000	AC134027		
Finish File	AC134026	AC134032		
Post-Verification	AC134CAA	AC134CAA		
Depth Return Error (in.)	0.0	0.0		
Comments	No fine gain adjustment made.	Repeat section		

Logging Operation Notes:

SGLS logging was conducted without a centralizer on the sonde. HRLS logging was conducted with a centralizer on the sonde. Measurements are referenced to the TOC. Repeat sections were collected in this borehole to evaluate the logging systems' performances. The borehole was logged from approximately 1 ft. above GWL to surface.

Analysis Notes:

Analyst:	Pope	Date:	05-09-06	Reference:	GJO-HGLP 1.6.3, Rev. 0

Pre-run and post-run verifications for the logging systems were performed before and after each day's data acquisition. Acceptance criteria were met for all systems.

SGLS and HRLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated using the EXCEL worksheet templates identified as G1Emar05.xls and G1CApr05.xls for the SGLS and HRLS data, respectively, using efficiency functions and corrections for casing, water, and dead time as determined from annual calibrations. A casing correction for 0.625-in.-thick casing was applied to the SGLS and HRLS data from 0.0 to 140.0 ft. A casing correction for 0.3125-in.-thick casing was applied to the SGLS data from 141.0 ft to depth. Dead time corrections are applied where dead times exceed approximately 11 percent. Where SGLS dead time exceeds 40 percent, HRLS data are substituted. Correction for water was not needed in this borehole.

Results and Interpretations:

A nearly continuous zone of ^{137}Cs was detected from 4 to 57 ft, with gaps at 5 and 9 ft. A zone of high ^{137}Cs concentrations exists from approximately 13 to 30 ft. The maximum concentration is approximately 31,000 pCi/g at 16.5 ft. A second zone of higher ^{137}Cs concentrations exists between 42 and 50 ft, with a maximum concentration of approximately 300 pCi/g at 47 ft. Below these zones, ^{137}Cs was detected at three depths in the logged section (0 to 346 ft) of the borehole at concentrations just above the minimum detectable level (MDL) (approx. 0.2 to 0.3 pCi/g).

^{60}Co is detected sporadically at discrete depths from 32 to 39 ft, and from 100 to 115 ft, at concentrations from about 0.1 to 0.2 pCi/g. A continuous zone of ^{60}Co extending from 43 to 76 ft has a peak concentration of approximately 0.7 pCi/g at 66 ft. It is possible that ^{60}Co also exists in the high rate interval from 13 to 30 ft at higher concentrations.

^{154}Eu was detected from 25 to 27 ft with a maximum concentration of 3.7 pCi/g at 25 ft. It is possible that ^{154}Eu also exists elsewhere in the high rate interval (about 13 to 30 ft) at higher concentrations.

^{125}Sb was not detected in the logged section of the borehole, though it was previously identified in a 1992 log (discussed further below) at sporadic locations between 4 and 151 ft (the 1992 logged section), with a nearly continuous interval from about 26 to 49 ft. The MDL for ^{125}Sb is normally around 1 pCi/g, which is approximately the expected maximum concentration of the remaining ^{125}Sb, as quantified in 1992, after accounting for decay. It is possible that ^{125}Sb exists in the high rate interval from 13 to 30 ft at higher concentrations.

Gamma activity from natural uranium is usually dominated by emissions from ^{238}U daughters such as ^{226}Ra, ^{214}Pb, and ^{214}Bi. These isotopes occur in the lower part of the decay chain and achieve secular equilibrium with the parent ^{238}U over a time frame approaching a million years. Processed uranium refers to material that has been chemically purified. The purification process removes the daughter elements and thus manmade uranium can be differentiated from natural uranium by the absence of gamma rays from long-term daughters combined with the presence of less intense gamma rays from short-term daughters.

The primary gamma activity associated with manmade uranium originates from ^{234m}Pa. The 1001-keV gamma ray is the most intense (0.84% yield), and a confirming line occurs at 766 keV (0.29% yield). These lines are seldom strong enough to be detected in natural uranium at background levels, but can be detected when manmade uranium concentrations exceed 10 pCi/g. Natural uranium is most commonly detected and quantified from gamma rays at 1764 or 609 keV (yields of 15.4% and 44.8%, respectively), at levels below 1 pCi/g. These gamma rays originate from ^{214}Bi, which is far down in the decay series and therefore not present in detectable amounts in manmade uranium.

Processed uranium also contains ^{235}U in various amounts according to the enrichment used for the reactor fuel at Hanford and burn up time. This radionuclide can be measured directly from energy peaks at approximately 186, 202, and 205 keV. The highest yield (57.2 %) is from the 186 keV gamma ray, which is used to assay ^{235}U.

Inconclusive evidence of processed uranium exists at the 47 ft interval in this borehole. The concentration is 24.4 pCi/g, just above the MDL of 22.0 pCi/g for this spectrum. Although no detections of processed uranium exist in the high activity zone between 13 and 30 ft, it cannot be ruled out in that interval. This instance of processed uranium in this borehole was identified using the 1001 keV gamma ray of ^{234m}Pa. The 766 keV line was not identified by the analysis software, but was observed as a small peak above background during visual inspection of the spectrum. ^{235}U was not identified at all, which, if it is there, is expected due to the attenuation of the low-energy gamma rays in the double casing.

The repeat sections for the HRLS and SGLS indicate good agreement for both the naturally occurring and man-made radionuclides. Accumulated radon is indicated in the SLGS repeat data as determined by an elevated 1764-keV energy peak. Additionally, the persistent presence of the 295-keV energy peak in spectra collected on July 27, 2005 (78 to 181 ft) suggests elevated radon is a likely contributor to the 1764-keV energy peak for that day.

Spectral gamma data were acquired in this borehole in 1992 by Westinghouse Hanford Company, and in 1999 by Waste Management Federal Services NW using the Radionuclide Logging System (RLS). These logs are attributed to 299-E13-03. A comparison of 1992 and 1999 RLS spectral data with the current SGLS and HRLS data indicate two notable changes through time: a small increase in ^{137}Cs concentrations between about 54 and 57 ft between 1992 and 1999, and the possible occurrence of processed uranium at 47 ft identified in the 2005 log. Spectra from neither the 1992 log, nor the 1999 log exhibit indications of processed uranium around the 47 ft depth, though in both instances the logging systems and parameters may not have been adequate for resolving relatively low concentrations of ^{238}U in a double-cased borehole. Otherwise, there is good agreement between the three logs, and no other significant changes are noted since 1992.

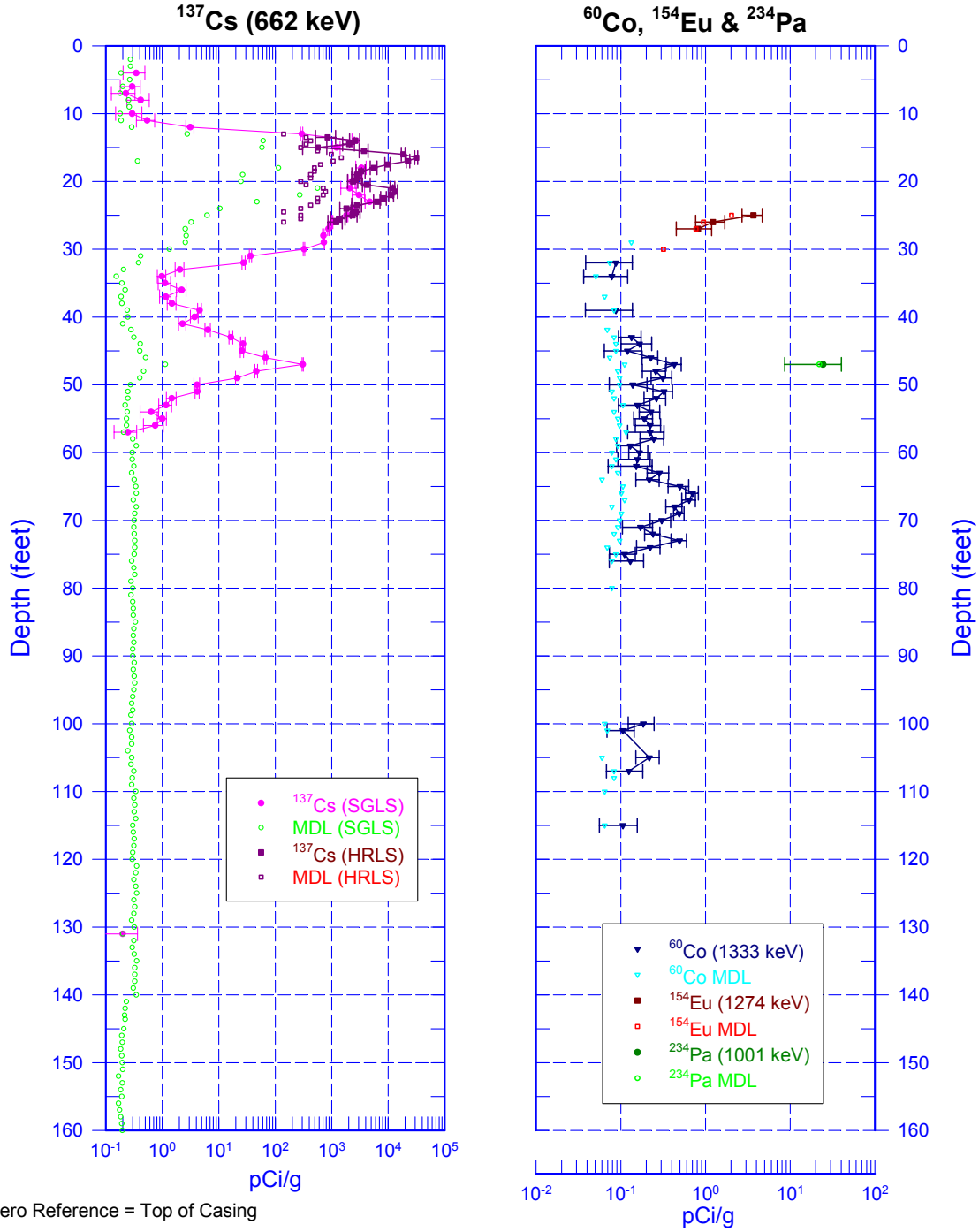
Total gamma data from 1956 to 1976 are available for boreholes 299-E13-21 and 299-E13-03. Both sets of data were plotted against total gamma data from the 1992, 1999, and 2005 logs. However, because of the confusion between the two boreholes, as described previously, it is not possible to be sure which data are from which borehole. Neither set of data yield a profile that can be matched conclusively with the more recent profiles. Therefore the historical total-gamma plots are not presented here. It can be stated, though, that both sets of data indicate decay of short-lived isotopes over the course of a few decades, resulting in a profile likely dominated by primarily ^{137}Cs, and secondarily by ^{60}Co and ^{154}Eu.

This borehole represents a second possible occurrence of ^{238}U in the B/C cribs area, and detection levels are only slightly above the MDL. The first observation of processed uranium in the B/C cribs area was recently documented in borehole 299-E13-05 near the 216-B-18 crib. It is strongly recommended that selected intervals in this borehole be re-logged using a long count time to confirm the presence of processed uranium.

List of Log Plots:

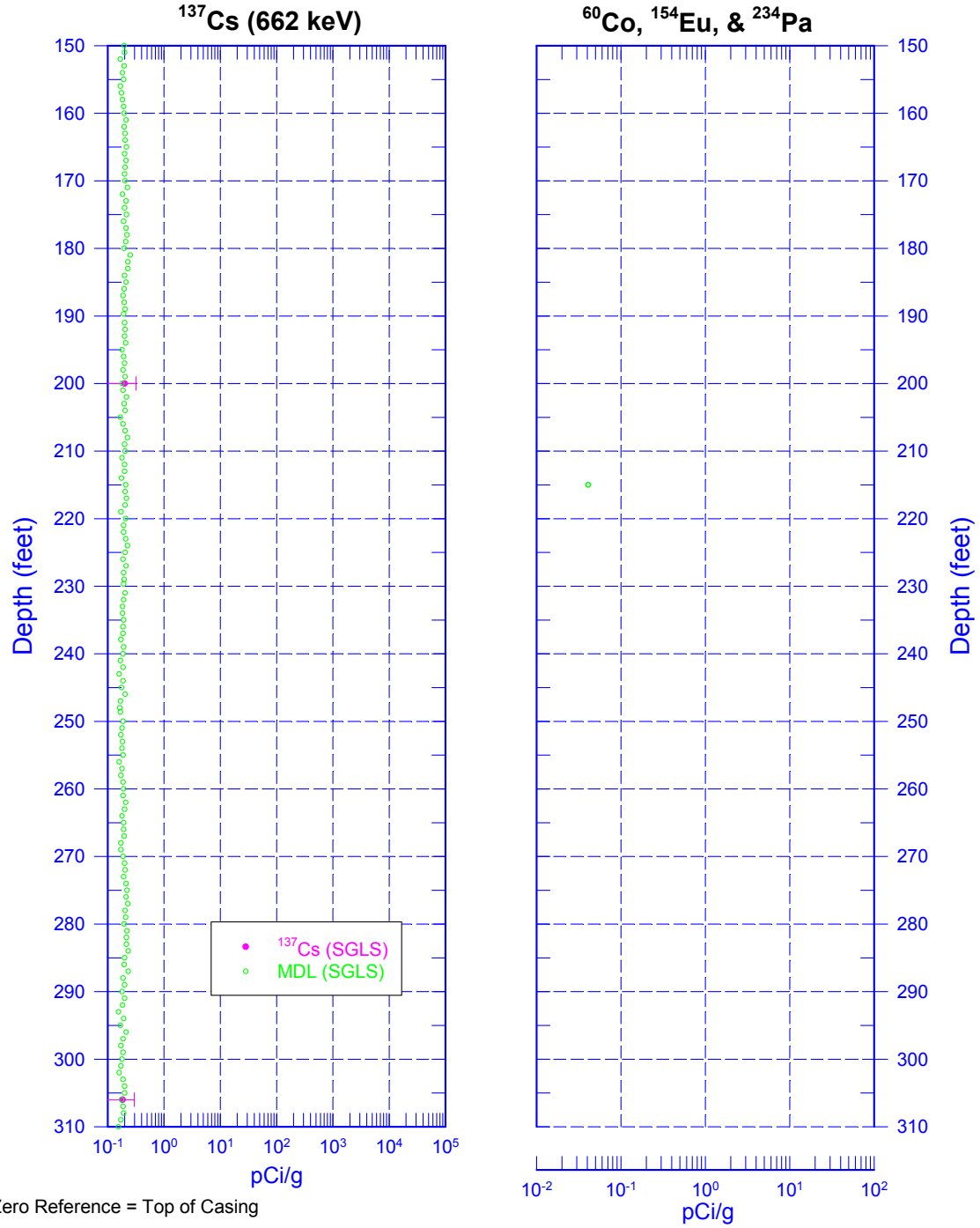
Man-Made Radionuclides
Natural Gamma Logs
Combination Plot
Total Gamma and Dead Time
Repeat Section of Man-made Radionuclides
Repeat Section for Natural Gamma Logs
HRLS Repeat Section
SGLS/RLS Man-Made Comparison Logs
Map of Crib Plot Plans for 216-B-14 through 216-B-19 (reproduced from ARH-ST-156)

299-E13-21 (A5866)
Man-Made Radionuclides



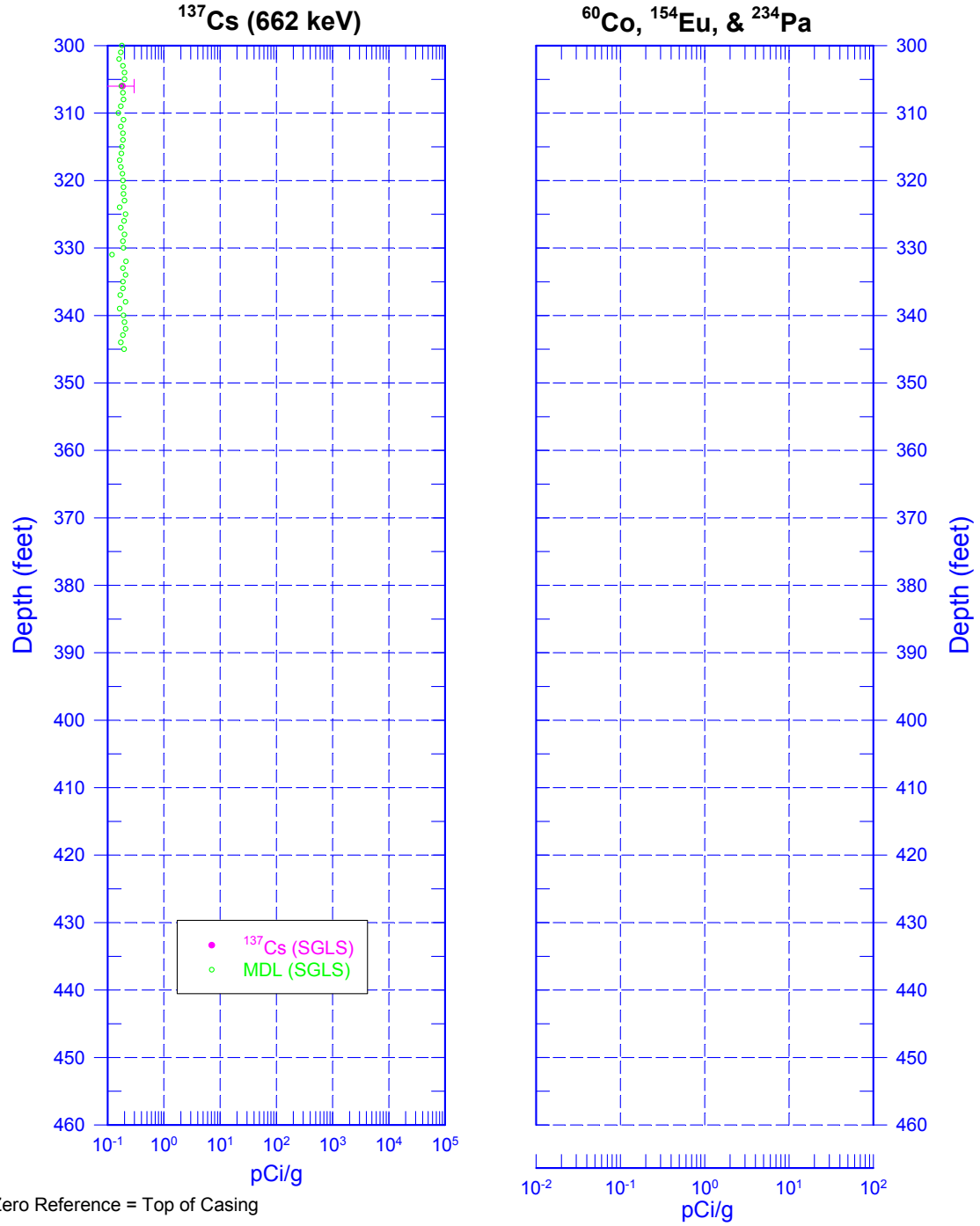
Zero Reference = Top of Casing

299-E13-21 (A5866)
Man-Made Radionuclides



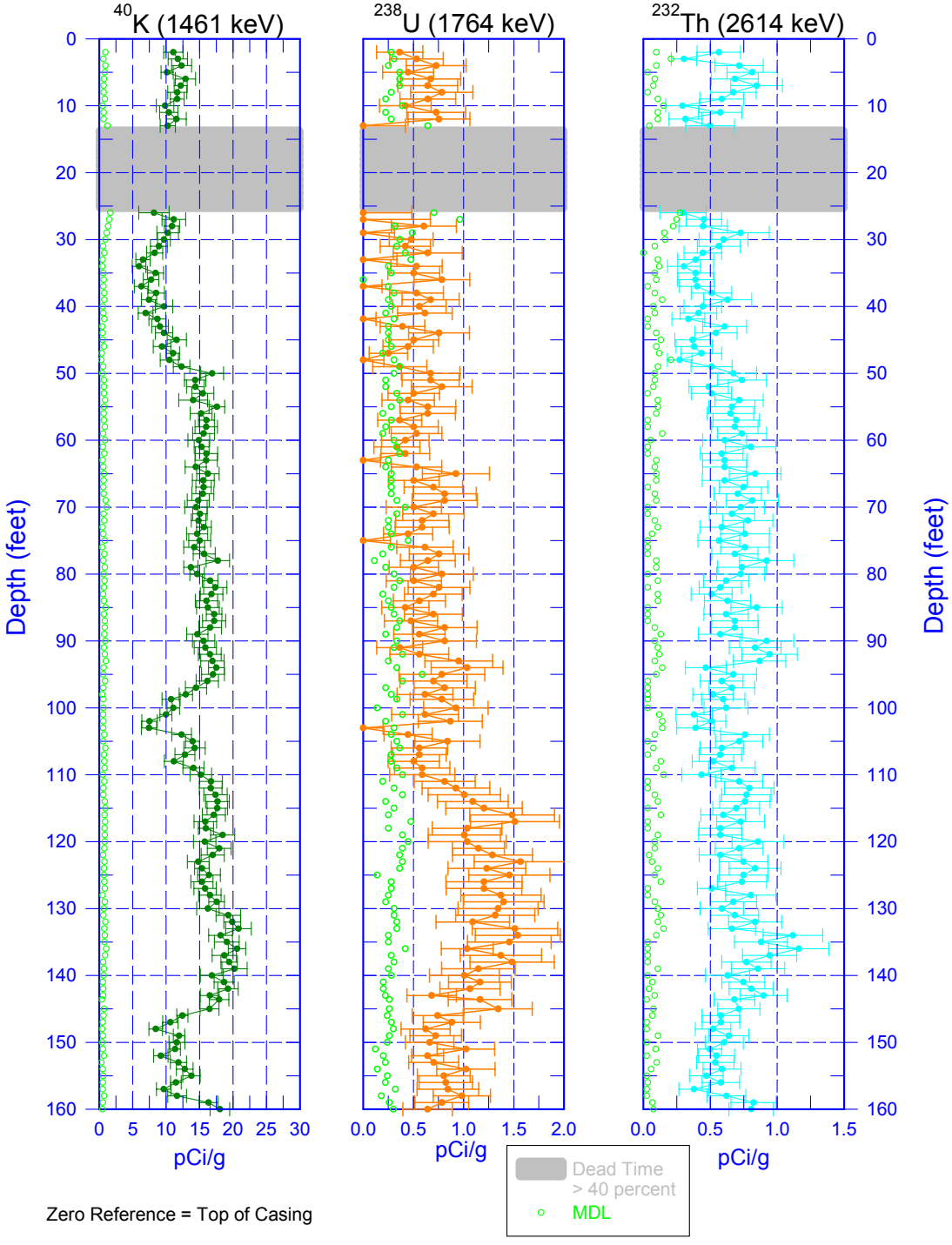
Zero Reference = Top of Casing

299-E13-21 (A5866)
Man-Made Radionuclides



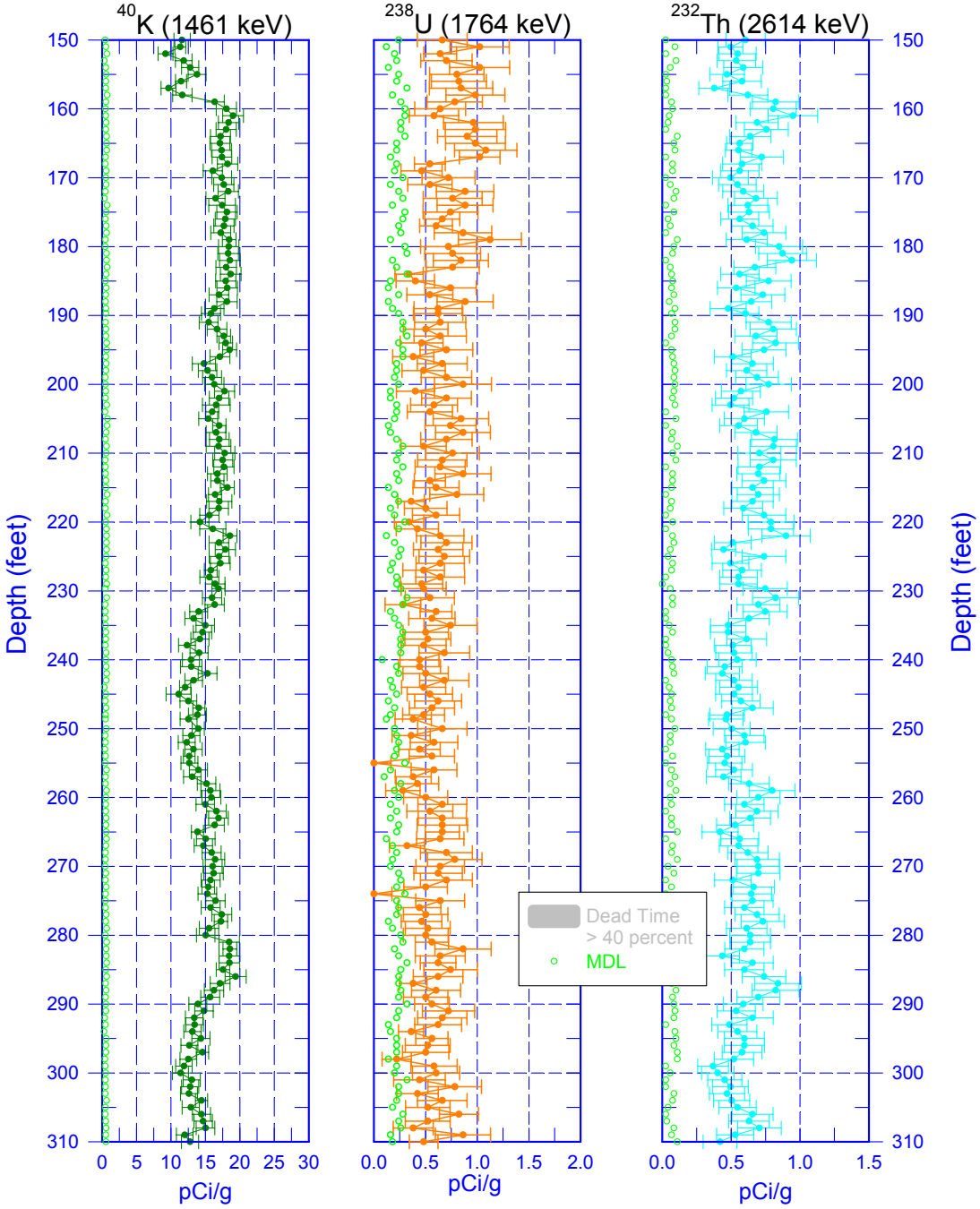
Zero Reference = Top of Casing

299-E13-21 (A5866)
Natural Gamma Logs



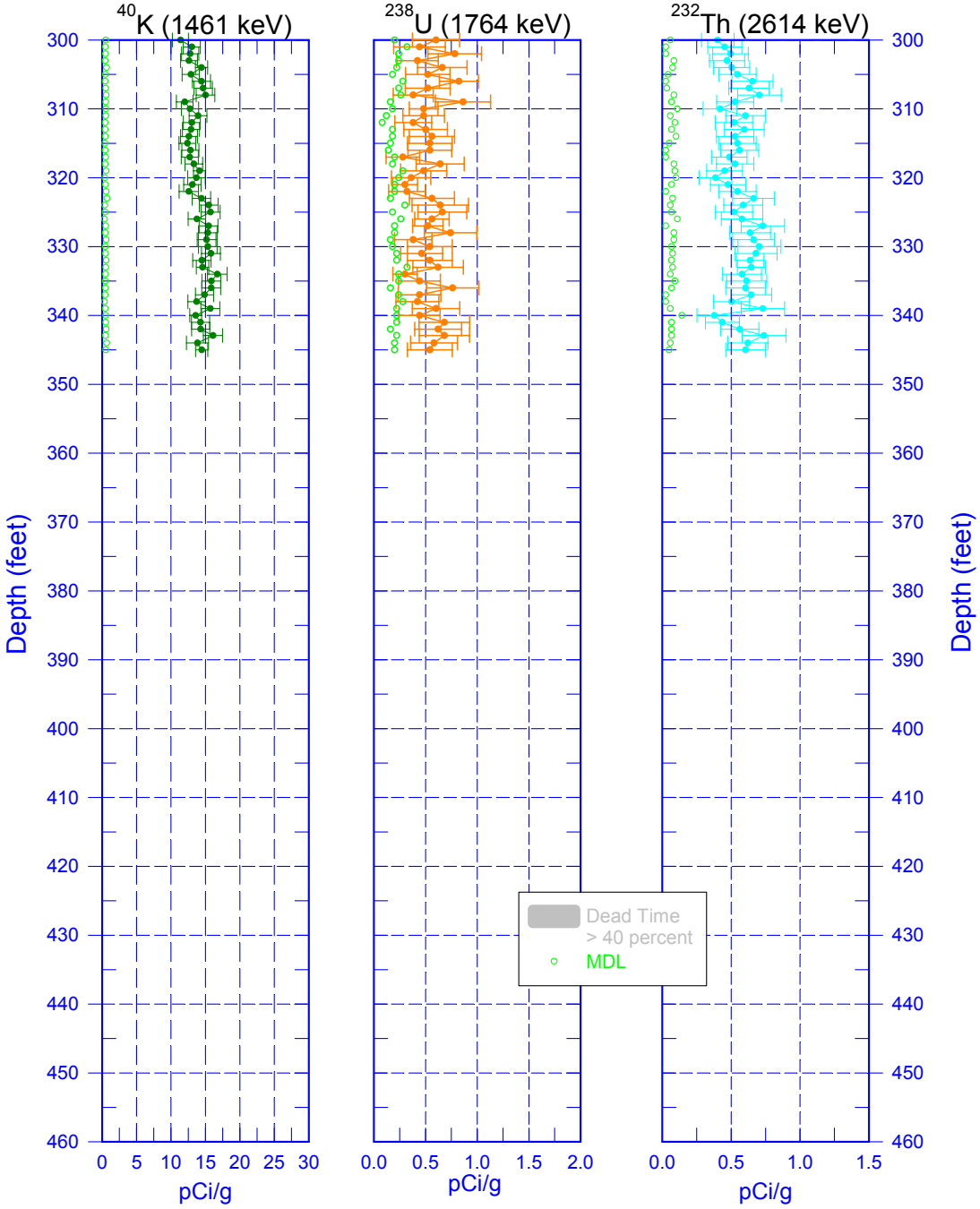
Zero Reference = Top of Casing

299-E13-21 (A5866)
Natural Gamma Logs



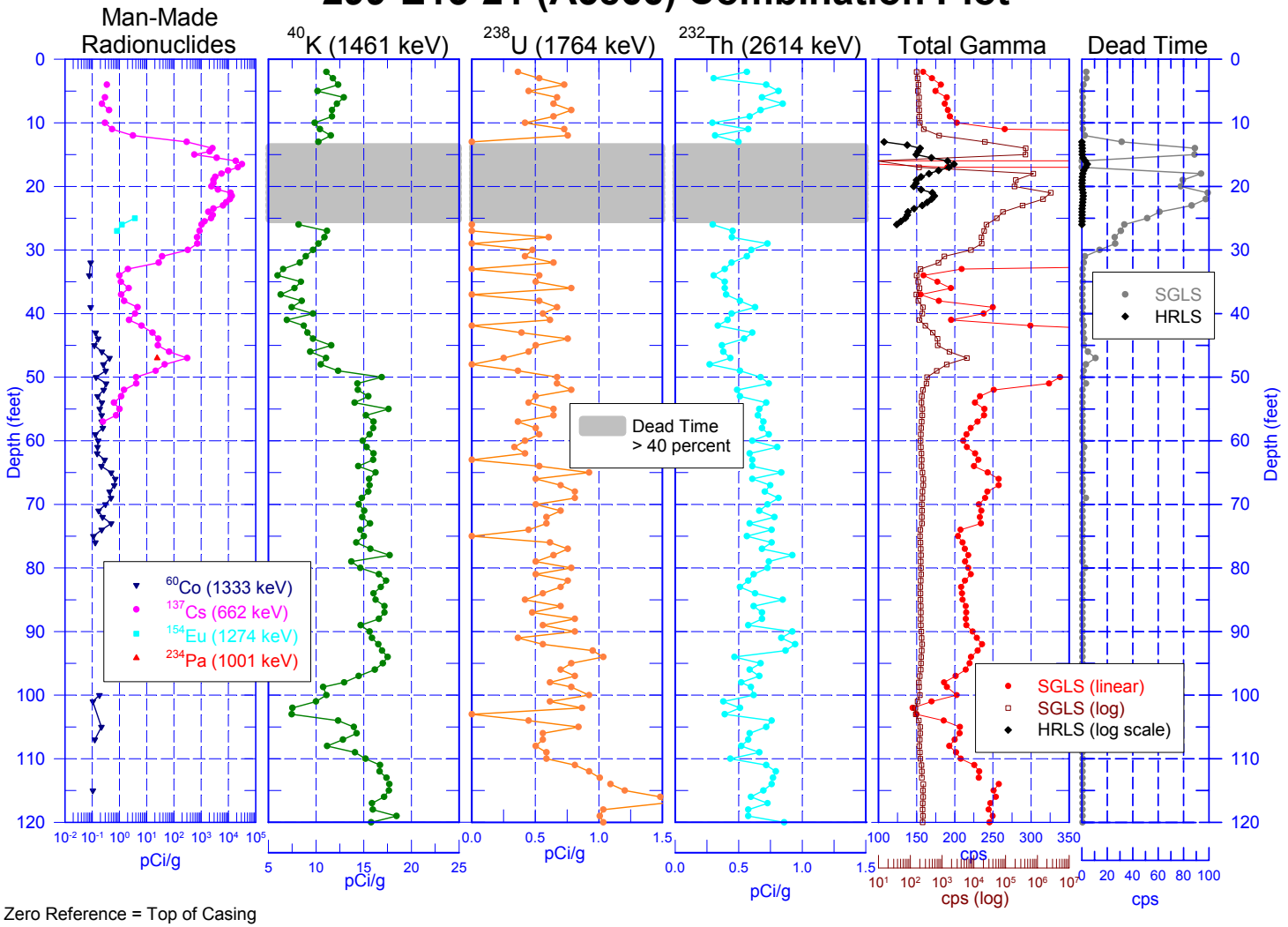
Zero Reference = Top of Casing

299-E13-21 (A5866)
Natural Gamma Logs



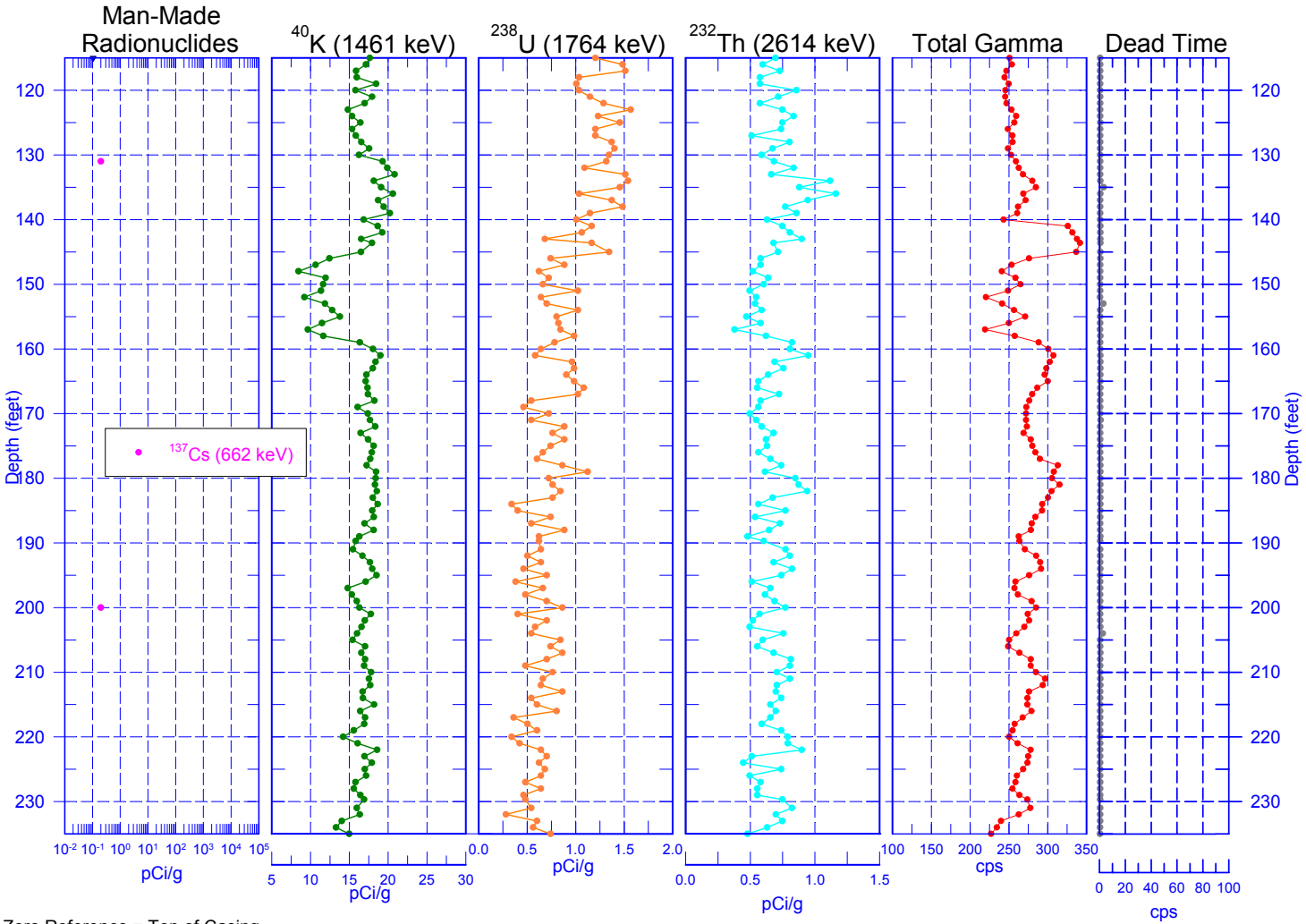
Zero Reference = Top of Casing

299-E13-21 (A5866) Combination Plot



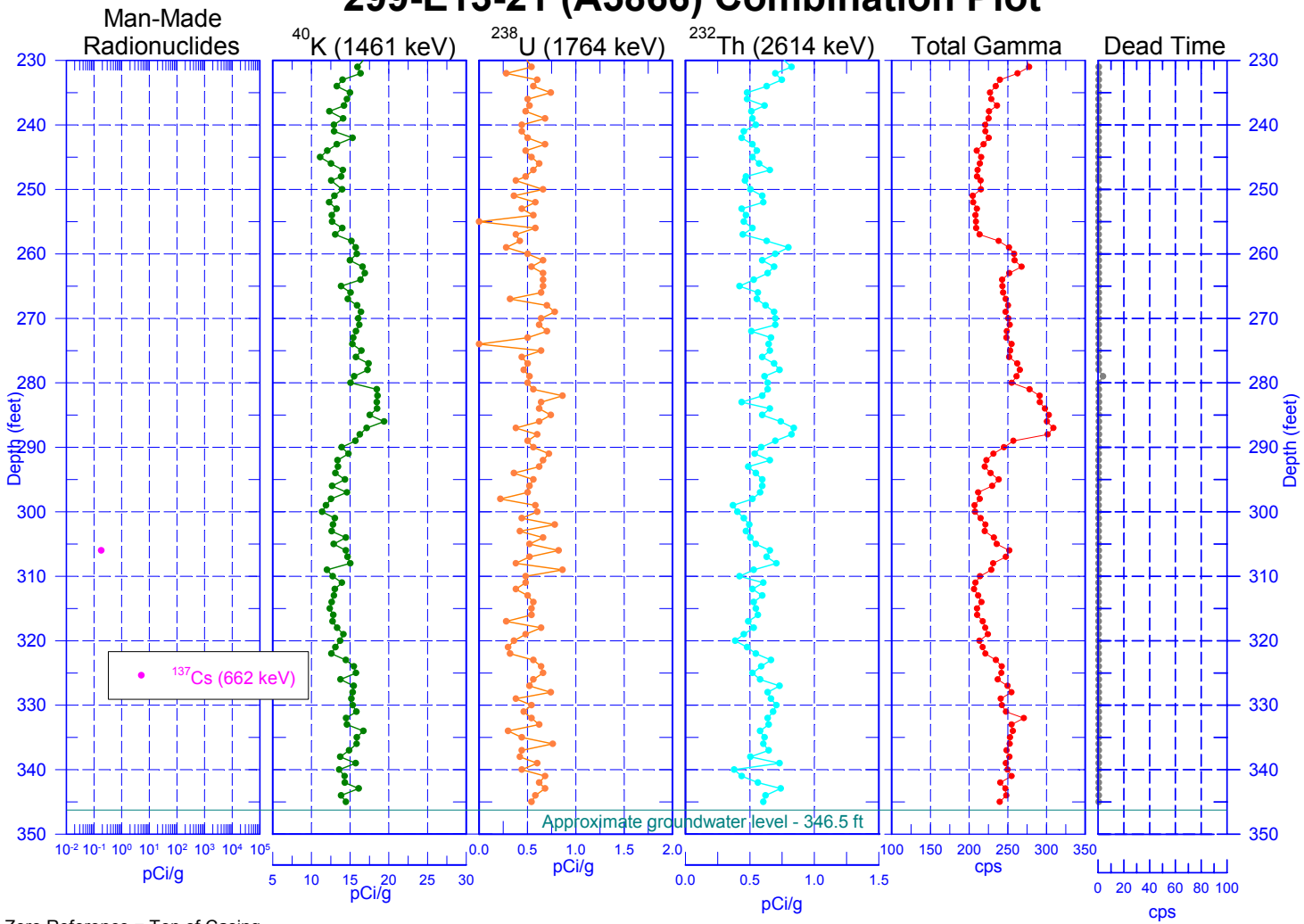
Zero Reference = Top of Casing

299-E13-21 (A5866) Combination Plot



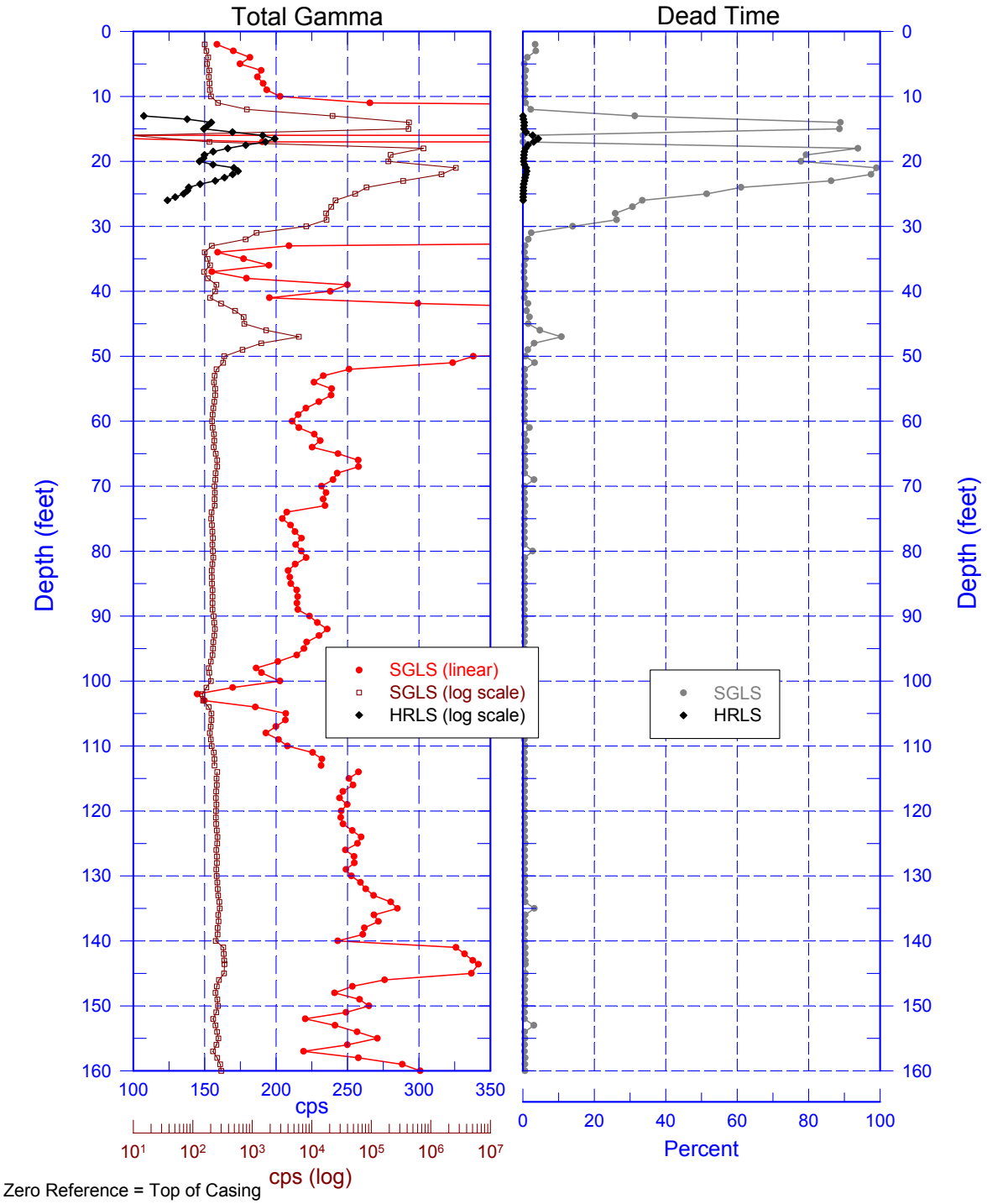
Zero Reference = Top of Casing

299-E13-21 (A5866) Combination Plot



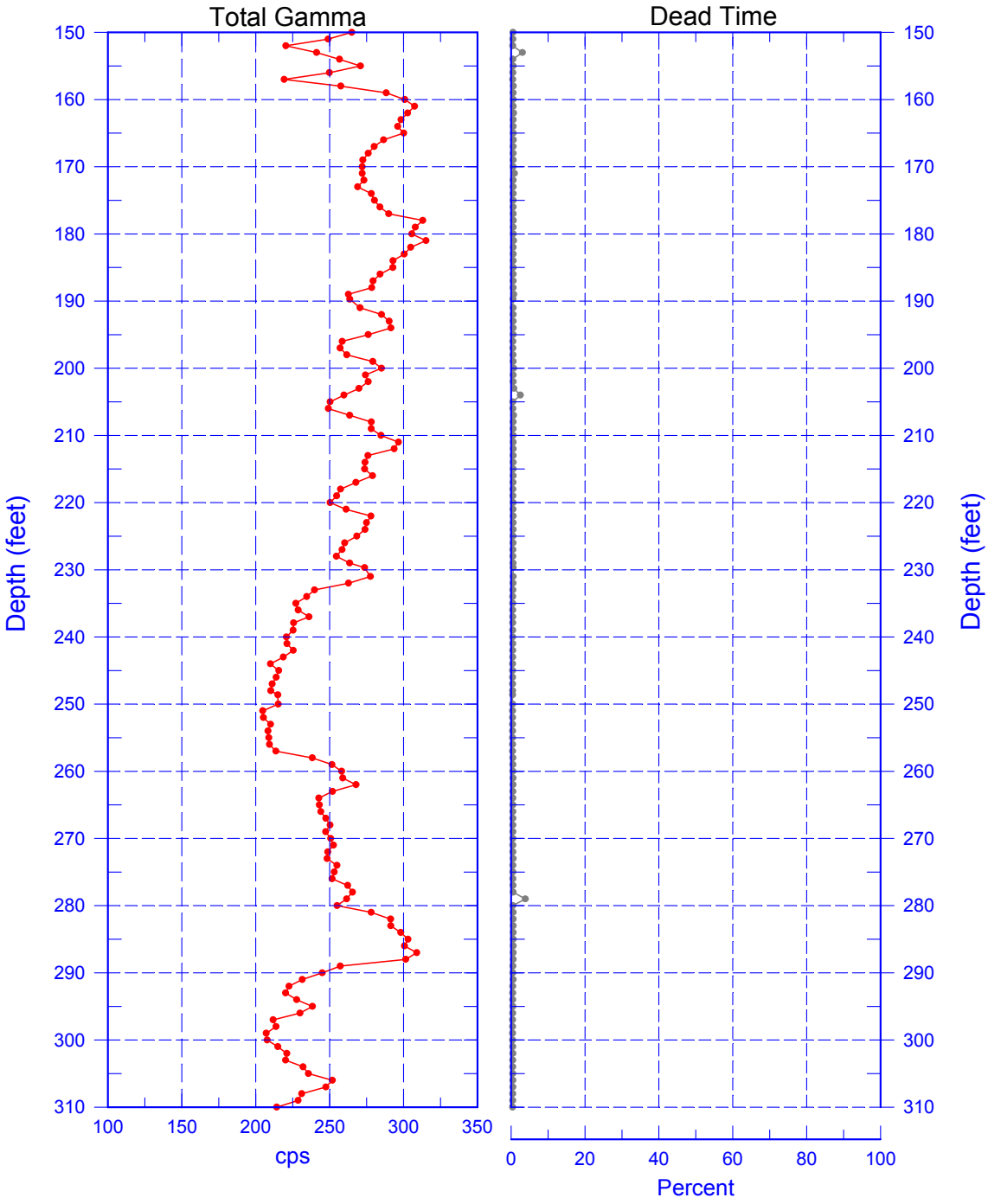
Zero Reference = Top of Casing

299-E13-21 (A5866)
Total Gamma & Dead Time



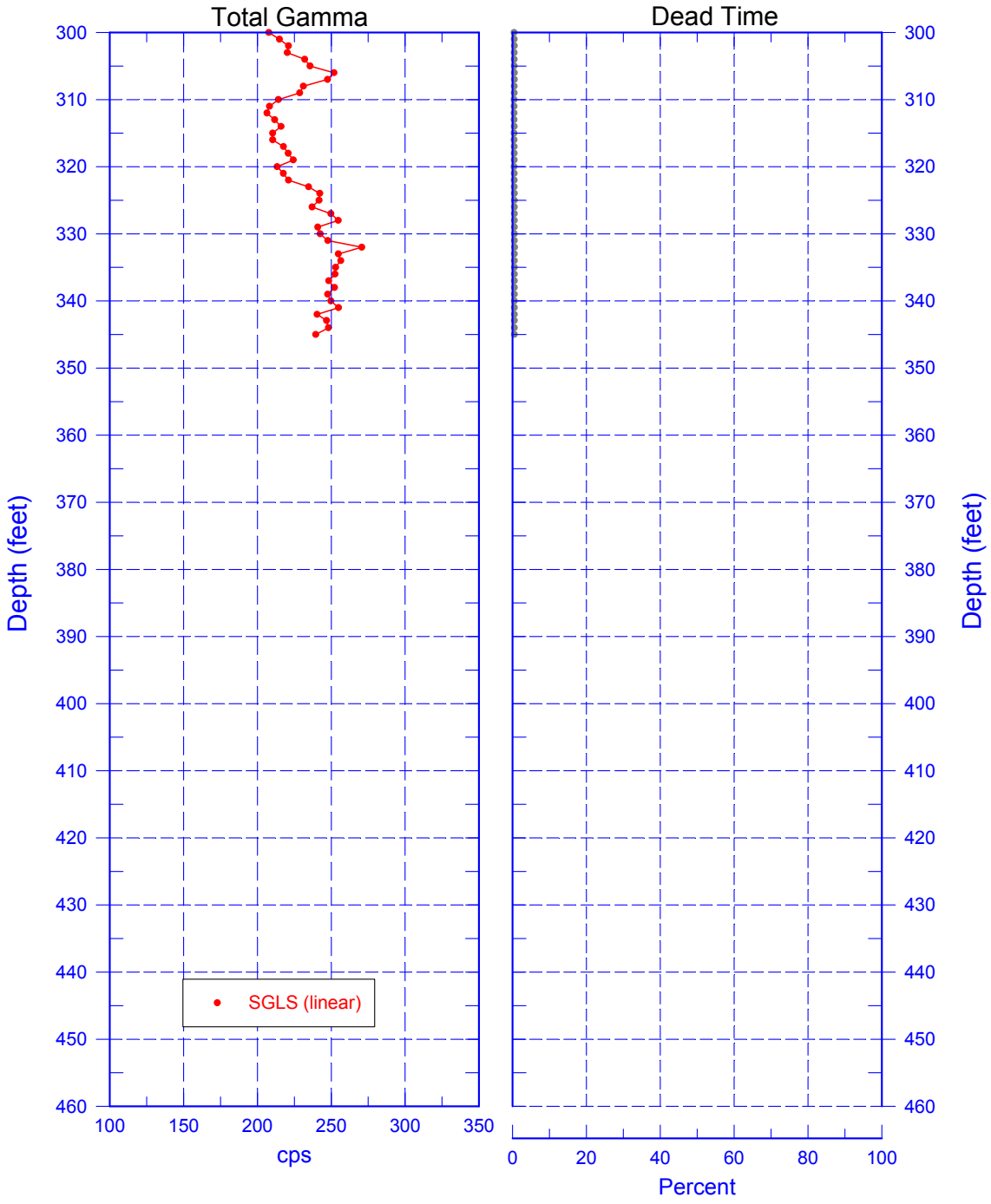
Zero Reference = Top of Casing

299-E13-21 (A5866)
Total Gamma & Dead Time



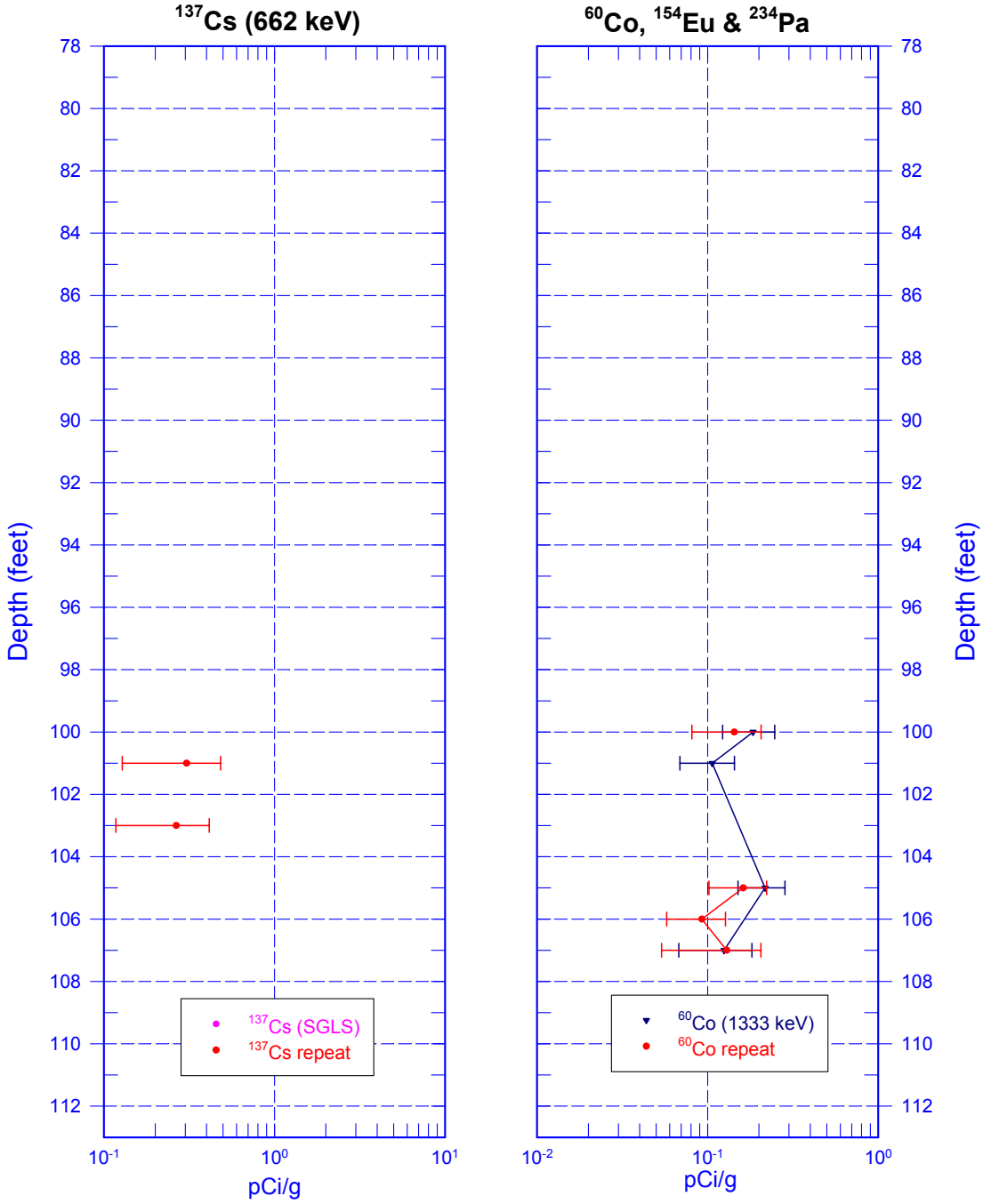
Zero Reference = Top of Casing

299-E13-21 (A5866)
Total Gamma & Dead Time



Zero Reference = Top of Casing

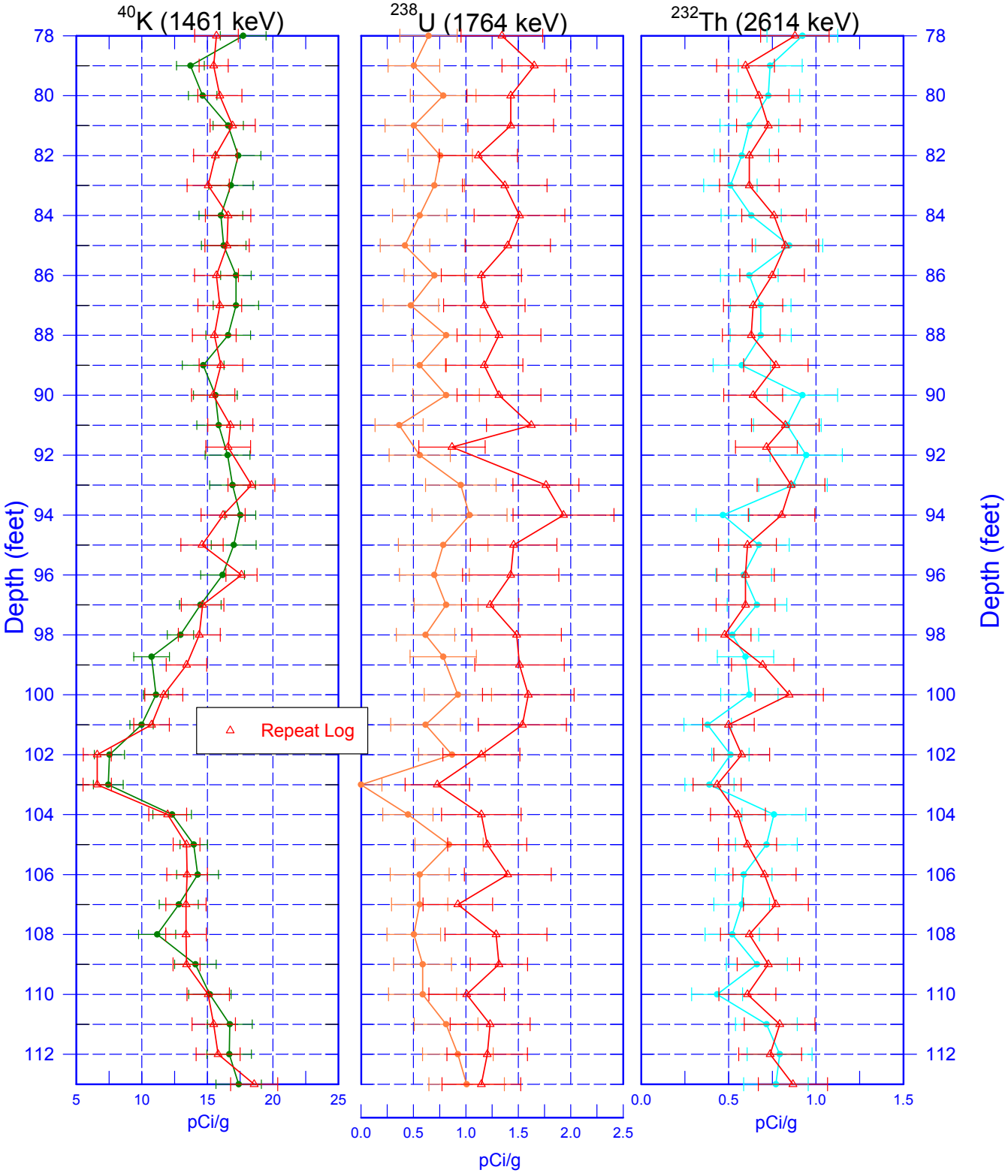
299-E13-21 (A5866)
Repeat Section of Man-Made Radionuclides



Zero Reference = Top of Casing

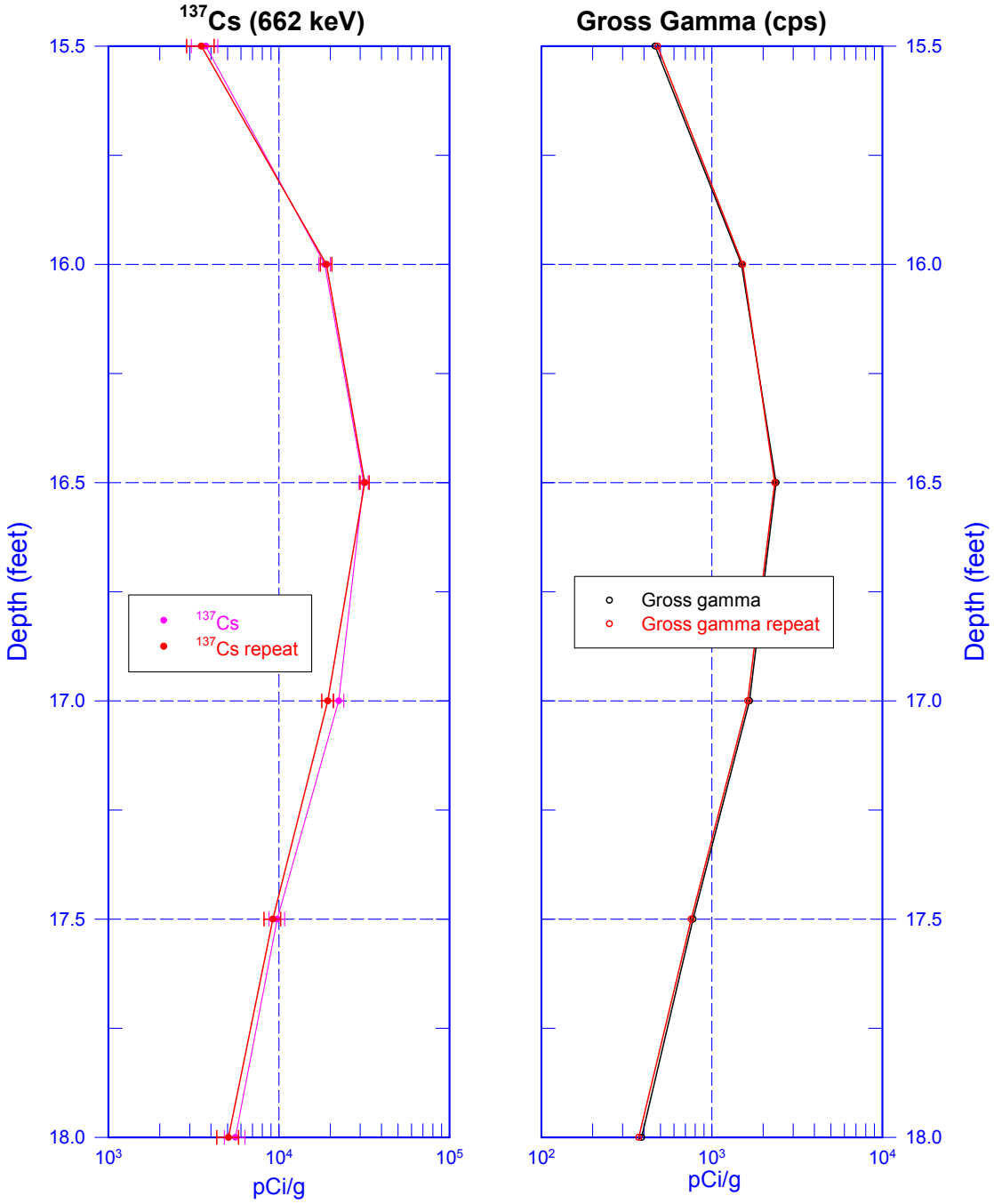
299-E13-21 (A5866)

Repeat Section of Natural Gamma Logs



Zero Reference = Top of Casing

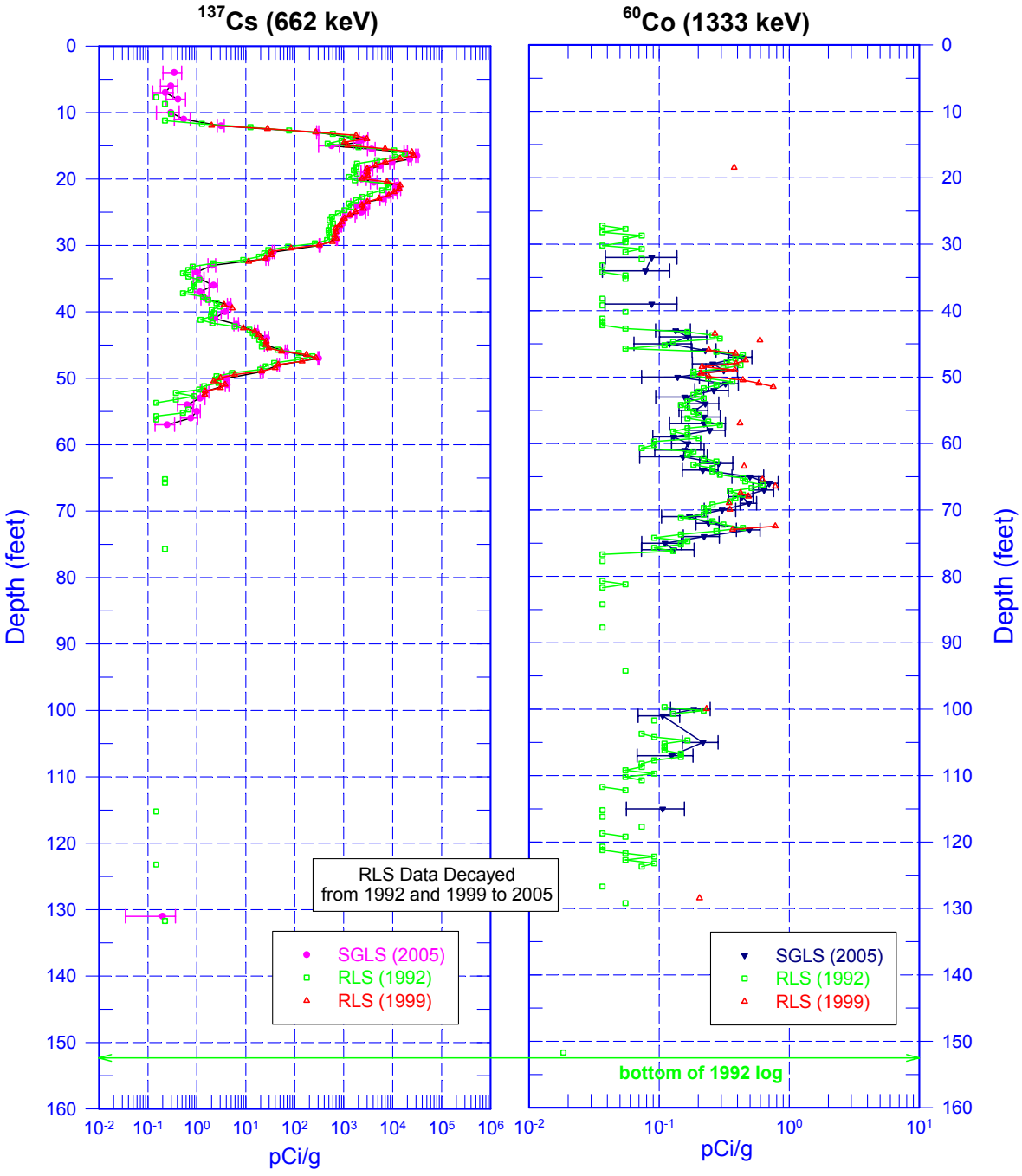
299-E13-21 (A5866)
HRLS Repeat Section



Zero Reference = Top of Casing

299-E13-21 (A5866)

SGLS & RLS Man-Made Radionuclide Comparison



Zero Reference = Top of Casing

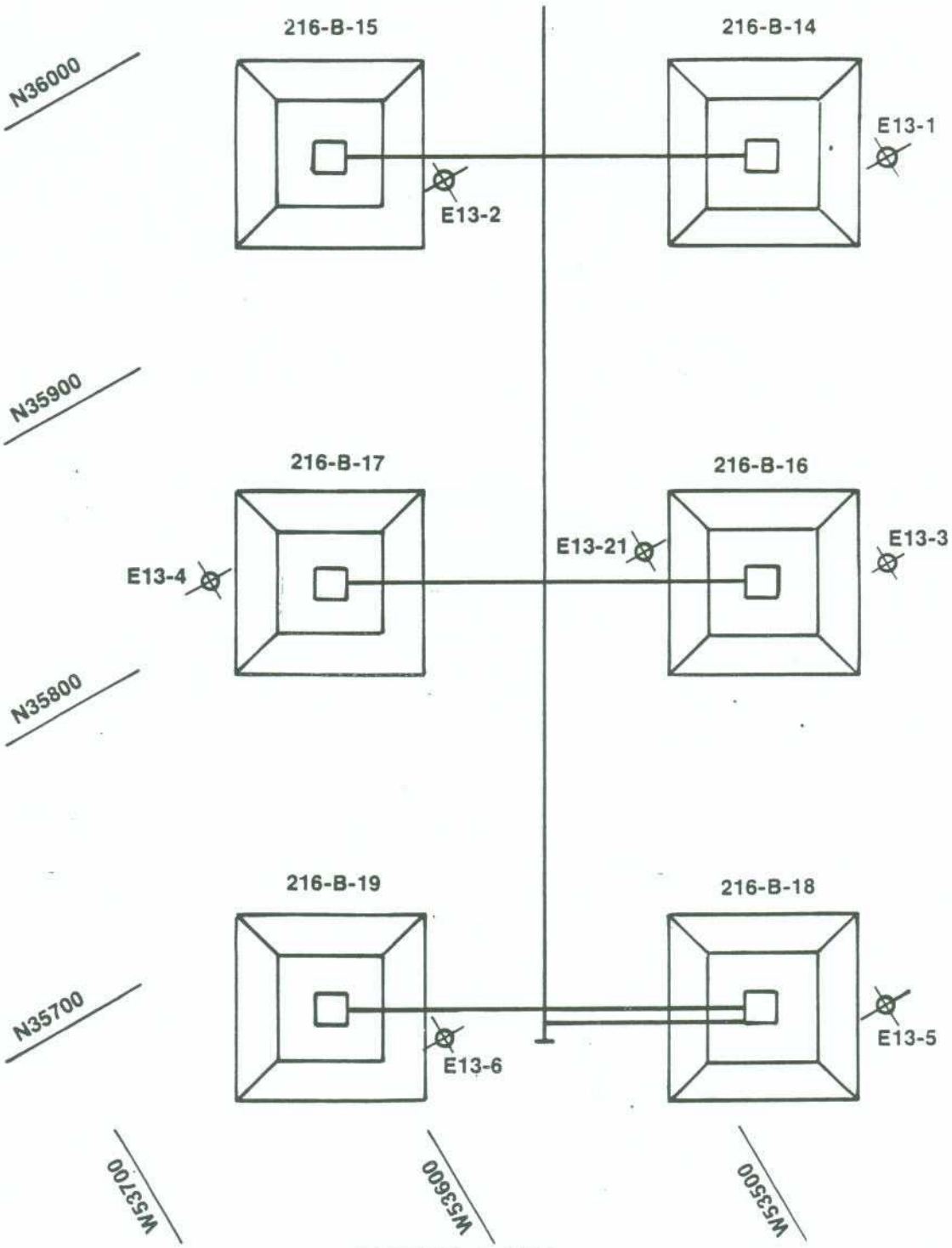


FIGURE A-94

216-B-14 THROUGH 216-B-19
CRIB PLOT PLANS